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An Experimental Study of the Influence of Particle Breakage on the Interface Friction Angle and Shear Strength of Carbonate Sands

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Abstract : Particle breakage occurs even in strong silica sand particles. There is compelling evidence that suggests that particle breakage causes changes in several properties such as permeability, peak strength, dilatancy and critical state friction angle. Current pile design methods that are based on soil properties do not account for particle breakage that occurs during driving or jacking of displacement piles. This may lead to significant overestimation of pile capacity in sands dominated by particles susceptible to breakage, such as carbonate sands. The objective of this paper is to study the influence of shear displacement on particle breakage and friction angle of carbonate sands, and to furthermore quantify the change in friction angle observed with different levels of particle breakage. To study the phenomenon of particle breakage, multiple ring shear tests have been performed at different levels of vertical confinement on a thoroughly characterized carbonate sand to find i) the shear displacement necessary to reach stable friction angles and ii) the effect of particle breakage on the mobilized friction angle of the tested sand. The findings of this study can potentially be used to update the current pile design methods by developing a friction angle which is a function of shear displacement and breakage characteristics of the sand instead of being a constant value.

Keywords : breakage, carbonate sand, friction angle, pile design, ring shear test
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